

WHAT IS CLAIMED IS:

1. An attachment assembly for securing a graft for repairing a vessel having an aneurysm therein, wherein the vessel has a proximal end and a distal end and the graft has a proximal end and a distal end, said attachment assembly comprising:

attachment means for securing the distal end of the graft to the distal end
5 of the vessel; and

graft attachment means for securing the distal end of the graft to said attachment means, wherein said attachment means accommodates expansion of the vessel neck without negatively impacting the connection between the distal end of the graft and the vessel.

2. The attachment assembly according to claim 1, wherein said attachment means comprises a radially extending cuff.

3. The attachment assembly according to claim 2, wherein said attachment means comprises at least one graft attachment leg for receiving the distal end of the proximal graft.

4. The attachment assembly according to claim 1, wherein said attachment means comprises at least one graft attachment leg for receiving the distal end of the graft.

5. The attachment assembly according to claim 1, wherein said attachment assembly is formed from a flexible material.

6. A repair graft assembly for repairing a vessel having an aneurysm therein, wherein the vessel has a proximal end and a distal end, said repair graft assembly comprising:

a proximal graft assembly for creating a passageway within the vessel to reinforce the aneurysm, wherein said graft having a proximal end and a distal end; and

5 an attachment assembly comprising attachment means for securing said distal end of said proximal graft assembly to said distal end of the vessel, and graft attachment means for securing said distal end of said proximal graft assembly to said attachment means, wherein said attachment means accommodates expansion of the vessel without negatively impacting the connection between said distal end of said proximal graft assembly and the vessel.

7. The repair graft assembly according to claim 6, wherein said attachment means comprises a radially extending cuff.

8. The repair graft assembly according to claim 7, wherein said attachment means comprises at least one graft attachment leg for receiving said distal end of said proximal graft assembly.

9. The repair graft assembly according to claim 6, wherein said attachment means comprises at least one graft attachment leg for receiving said distal end of said proximal graft assembly.

10. The repair graft assembly according to claim 6, wherein said attachment assembly is formed from a flexible material.

11. The repair graft assembly according to claim 6, wherein said proximal graft assembly is formed from a flexible material.

12. The repair graft assembly according to claim 6, wherein said proximal graft assembly is a bifurcated graft.

13. The repair graft assembly according to claim 6, wherein said proximal graft assembly comprises proximal attachment means for securing said proximal end of said graft to the proximal end of the vessel.

14. The repair graft assembly according to claim 13, wherein said proximal attachment means comprises a radially extending cuff.

15. The repair graft assembly according to claim 14, wherein said proximal graft assembly is formed from a flexible material.

16. The repair graft assembly according to claim 14, wherein said proximal graft assembly is a bifurcated graft.

17. The repair graft assembly according to claim 16, wherein said attachment means comprises a radially extending cuff.

18. The repair graft assembly according to claim 17, wherein said attachment means comprises at least one graft attachment leg for receiving said distal end of said proximal graft assembly.

19. A visualization apparatus for viewing an interior of a vessel, said visualization apparatus comprising:

a housing; and

image creating means for creating an image of the interior of the vessel from within the vessel, wherein said image creating means is located within said housing.

20. The visualization apparatus according to claim 19, wherein the vessel contains blood, said image creating means comprises:

illumination means for illuminating an area within the vessel for viewing by a user;

5 diverting means for temporarily diverting the blood away from the area to be viewed; and

optical viewing means for viewing the area within the vessel.

21. The visualization apparatus according to claim 20, wherein said illumination means comprises an optical fiber for illuminating the area within the vessel.

22. The visualization apparatus according to claim 20, wherein said diverting means comprises:

means for supplying fluid to the area to divert the flow of blood away from the area; and

return means for returning blood to the area.

23. The visualization apparatus according to claim 22, wherein said fluid is one of a saline solution and a similar biocompatible material.

24. The visualization apparatus according to claim 20, wherein said optical viewing means comprises at least one optical fiber.

25. The visualization apparatus according to claim 19, wherein said image creating means comprises scanning means for scanning an area of the vessel for creating an image of the area.

26. The visualization apparatus according to claim 25, wherein said scanning means produces an ultrasound image.

27. The visualization apparatus according to claim 25, wherein said scanning means comprises a scanning catheter.

28. A penetration apparatus for use in forming a treatment specific hole in a vessel that may contain a calcified portion therein, said penetration apparatus comprising:

a housing; and

penetration means for forming a treatment specific hole in the vessel through the calcified portion, wherein said penetration means is located within said housing.

29. The penetration apparatus according to claim 28, wherein said penetration means comprises a laser.

30. The penetration apparatus according to claim 29, wherein said laser is an acousto-optical laser.

31. The penetration apparatus according to claim 30, wherein said acousto-optical laser operates at a wavelength about $1.35 \mu\text{m}$.

32. The penetration apparatus according to claim 29, wherein said laser is a Holmium-Yag laser.

33. The penetration apparatus according to claim 32, wherein said Holmium-Yag laser operates at a wavelength about $2.1 \mu\text{m}$.

34. The penetration apparatus according to claim 28, wherein said penetration means comprises a piezoelectric penetrating device.

35. The penetration apparatus according to claim 28, further comprising:

insertion means for inserting a fastener through the treatment specific hole in the vessel to secure a surgical component to the vessel.

36. The penetration apparatus according to claim 35, wherein said surgical component is a repair graft assembly.

37. The penetration apparatus according to claim 28 further comprising:
secondary penetration means for forming at least one temporary hole adjacent the treatment specific hole in the vessel through the calcified portion.

38. The penetration apparatus according to claim 37, wherein said secondary penetration means comprises a laser.

39. The penetration apparatus according to claim 38, wherein said laser is an acousto-optical laser.

40. The penetration apparatus according to claim 39, wherein said acousto-optical laser operates at a wavelength about $1.35 \mu\text{m}$.

41. The penetration apparatus according to claim 38, wherein said laser is a Holmium-Yag laser.

42. The penetration apparatus according to claim 41, wherein said Holmium-Yag laser operates at a wavelength about $2.1 \mu\text{m}$.

43. The penetration apparatus according to claim 37, wherein said penetration means comprises a piezoelectric penetrating device.

44. The penetration apparatus according to claim 37, further comprising:

insertion means for inserting a fastener through the treatment specific hole in the vessel to secure a surgical component to the vessel.

45. The penetration apparatus according to claim 37, wherein said secondary penetration means stabilizes said penetration apparatus as said insertion means inserts a fastener in the treatment specific hole.

46. The penetration apparatus according to claim 35, further comprising:
secondary penetration means for forming at least one temporary hole adjacent the treatment specific hole in the vessel through the calcified portion.

47. The penetration apparatus according to claim 28, further comprising:
tracking means for tracking the location of said penetration apparatus within the vessel.

48. A repair apparatus for repairing a vessel during a surgical procedure, said apparatus comprising:

a housing; and
at least one of a penetration apparatus for use in forming a treatment specific hole in a vessel having a calcified portion and a visualization apparatus for viewing an interior of a vessel during a surgical procedure,

wherein said penetration apparatus comprises a penetration housing, and penetration means for forming a treatment specific hole in the potentially calcified vessel wall, and

wherein said visualization apparatus comprises a visualization housing, and image creating means for creating an image of the interior of the vessel from within the vessel.

49. The repair apparatus according to claim 48, wherein said housing is capable of interchangeably receiving said penetration apparatus and said visualization apparatus during a surgical procedure.

50. The repair apparatus according to claim 48, wherein said repair apparatus comprises said penetration apparatus and said visualization apparatus for viewing an interior of a vessel during a surgical procedure.

51. The repair apparatus according to claim 50, wherein the vessel contains blood, wherein said image creating means comprises:

illumination means for illuminating an area within the vessel for viewing by a user;

diverting means for temporarily diverting the blood away from the area for viewing; and

optical viewing means for viewing the area within the vessel.

52. The repair apparatus according to claim 51, wherein said illumination means comprises an optical fiber for illuminating the area within the vessel.

53. The repair apparatus according to claim 51, wherein said diverting means comprises:

means for supplying a flow of fluid to the area to divert the flow of blood away from the area; and

return means for returning blood to the area.

54. The repair apparatus according to claim 53, wherein said fluid is a saline solution.

55. The repair apparatus according to claim 51, wherein said optical viewing means comprises an optical fiber.

56. The repair apparatus according to claim 51, wherein said visualization means comprises scanning means for scanning an area of the vessel for creating an image of the area.

57. The repair apparatus according to claim 56, wherein said scanning means produces an ultrasound image.

58. The repair apparatus according to claim 56, wherein said scanning means comprises a scanning catheter.

59. The repair apparatus according to claim 51, wherein said penetration means comprises a laser.

60. The repair apparatus according to claim 59, wherein said laser is an acousto-optical laser.

61. The repair apparatus according to claim 60, wherein said laser operates at a wavelength about $1.35\mu\text{m}$.

62. The repair apparatus according to claim 59, wherein said laser is a Holmium-Yag laser.

63. The repair apparatus according to claim 62, wherein said laser operates at a wavelength about $2.1\mu\text{m}$.

64. The repair apparatus according to claim 51, wherein said penetration means comprises a piezoelectric penetrating device.

65. The repair apparatus according to claim 51, further comprising:
insertion means for inserting a fastener through the treatment specific hole in the vessel to secure a surgical component to the vessel.

66. The repair apparatus according to claim 65, wherein said surgical component is a repair graft assembly.

67. The repair apparatus according to claim 66, further comprising:
secondary penetration means for forming at least one temporary hole adjacent the treatment specific hole in the potentially calcified vessel wall.

68. The repair apparatus according to claim 67, wherein said secondary penetration means comprises a laser.

69. The repair apparatus according to claim 68, wherein said laser is an acousto-optical laser.

70. The penetration apparatus according to claim 69, wherein said acousto-optical laser operates at a wavelength about $1.35 \mu\text{m}$.

71. The repair apparatus according to claim 68, wherein said laser is a Holmium-Yag laser.

72. The penetration apparatus according to claim 71, wherein said Holmium-Yag laser operates at a wavelength about $2.1 \mu\text{m}$.

73. The repair apparatus according to claim 67, wherein said secondary penetration means comprises a piezoelectric penetrating device.

74. The repair apparatus according to claim 67, wherein said secondary penetration means stabilizes said penetration apparatus as said insertion means inserts a fastener in the treatment specific hole.

75. A fastener for use in a surgical procedure for securing a surgical component to a vessel, said fastener comprising:

fastening means for securing the surgical component to the vessel under a compressive force.

76. The fastener according to claim 75, wherein said fastening means is a spring assembly.

77. The fastener according to claim 76, wherein said spring assembly is a manipulated coil spring.

78. The fastener according to claim 76, wherein said fastening means comprises a ring type fastener having a pair of fastener legs incorporated therein.

79. The fastener according to claim 75, wherein said spring assembly comprises a pair of fastening legs.

80. The fastener according to claim 76, wherein said spring assembly is temporarily compressed during a fastening operation to secure the surgical component to the vessel.

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81. The fastener according to claim 75, wherein said spring assembly is temporarily elongated during a fastening operation to secure the surgical component to the vessel.

82. An introducer sheath device for use during a surgical procedure for introducing surgical components into a vessel into a patient, said introducer sheath device comprising:

5 a housing having a passageway that accommodates the passage of the surgical components therein;

sealing means for preventing the loss of blood from the vessel during the insertion and subsequent removal of surgical components during the surgical procedure.

83. The introducer sheath device according to claim 82, wherein said sealing means comprises a sealing cavity.

84. The introducer sheath device according to claim 82, wherein said sealing cavity is filled with a biocompatible sealing material, wherein said sealing material forms a seal around the surgical components as the components are inserted and removed from said introducer sheath device during the surgical procedure.

85. The introducer sheath device according to claim 82, further comprising:
positioning means for maintaining the position of said introducer sheath device in the vessel.

86. The introducer sheath device according to claim 85, wherein said positioning means comprises an inflatable cuff positioned at one end of said introducer sheath device.

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87. The introducer sheath device according to claim 86, wherein said positioning means comprises an inflatable cuff is filled with a fluid.

88. The introducer sheath device according to claim 86, wherein said sealing means comprises a sealing cavity.

89. The introducer sheath device according to claim 88, wherein said sealing cavity is filled with a sealing material, wherein said sealing material forms a seal around the surgical components as the components are inserted and removed from said introducer sheath device during the surgical procedure.

90. A method of repairing an aneurysm within a vessel having a distal end and a proximal end, said method comprising the steps of:

securing an attachment assembly to the vessel adjacent the distal end of the vessel;

securing a graft to the vessel adjacent the proximal end of the vessel; and

securing the graft to the attachment assembly.

91. The method of repairing according to claim 90, wherein said step of securing an attachment assembly to the vessel adjacent the distal end comprises securing an attachment cuff to the distal end of the vessel.

92. The method of repairing according to claim 90, further comprising the step of viewing an area adjacent the distal end of the vessel.

93. The method of repairing according to claim 90, wherein said step of securing an attachment assembly to the vessel adjacent the distal end comprises the steps of:

5 and

viewing an area adjacent the distal end of the vessel;
creating treatment specific holes within the vessel and attachment assembly;

inserting a fastener in said treatment specific holes.

94. The method of repairing according to claim 90, wherein said step of securing a graft to the vessel adjacent the proximal end comprises the steps of:

viewing an area adjacent the proximal end of the vessel;
applying a fastener to secure said graft to said vessel.

95. The method of repairing according to claim 90, wherein said step of securing a graft to the vessel adjacent the proximal end comprises the steps of:

viewing an area adjacent the proximal end of the vessel;
creating treatment specific holes within the vessel and graft; and
inserting a fastener in said treatment specific holes.

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